

Implications of the Global Energy Transition on Russia



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1 What Is Energy Transition and How Does It Affect Different Countries?

The current energy transition can be viewed as the fourth in a series of similar fundamental structural transformations of the global energy sector. V. Smil defines the first energy transition—from biomass to coal—as the period between 1840 and 1890 during which the share of coal in the energy balance increased from 5 to 50% (Smil 2018). The second energy transition is associated with the fast penetration of oil—its share grew from 3% in 1915 to 45% by 1975—and the third transition involved the partial replacement of both coal and oil by natural gas, the share of which increased from 3% in 1930 to 23% in 2017. All these transitions were driven by the comparatively higher economic efficiency of the new energy sources. Currently, however, as we are talking about the beginning of the fourth energy transition (from fossil fuels to low-carbon energy sources), the situation is quite different. The share of Renewable Energy Sources (RES) (excluding hydro) in total primary energy consumption in 2017 was 3%, but it is now expanding very quickly. In this fourth energy transition, in contrast to the previous three, a qualitative new driver is becoming critically important, namely, combating global climate change, which has led to the establishment of compulsory energy sector decarbonization targets.

In a more specific sense, energy transition is a translation of the German term “Energiewende”, which came into international use in the early 2010s after the accident at the Fukushima nuclear power plant (OSCE 2013; Trüby and Schiffer 2018). As one of the most ambitious decarbonization projects for the energy sector on a

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national scale (aiming for a reduction of greenhouse gas emissions by 40% by 2020 and by 80–95% by 2050 from 1990 levels), “Energiewende” became a benchmark for large-scale climate-driven transformations around the world.

Today, energy transition is driven by a complex set of different drivers: climate agenda, technological progress and the availability of brand new technological solutions which are able to dramatically increase the efficiency of the energy sector and to change the traditional way that it functions. It has the means to satisfy the desire of all countries to ensure the competitiveness of their national economies and to boost development with affordable energy. Last, but not least, it taps into the need to increase energy security, which, obviously, corresponds to the geopolitical agenda.

Basically, there are several ways in which energy transition affects different countries:

(1) Direct influence:

- Countries which sign up to international climate agreements are supposed to comply with their official targets and obligations, changing their energy mix; they have no choice other than to develop new low-carbon strategies with a strong focus on RES, energy efficiency and other ways to reduce emissions.
- Global innovation and technological development makes many new technologies cheaper and more attractive, so often countries—driven by local stakeholders—opt to promote these technologies voluntarily in order to decrease the cost of energy and to sustain their economic competitiveness.

(2) Indirect influence (refers mainly to countries which are lagging behind the energy transition):

- The changing global fuel mix with a growing share of RES limits the demand growth for fossil fuels, thus resulting in lower than expected export volumes for coal, oil and gas from resource-rich countries.
- New rules are under discussion in certain parts of the world concerning carbon tracking of internationally traded goods and the creation of border carbon adjustments (BCAs) as part of the carbon taxation mechanism (Morris 2018; Mehling et al. 2017). A high carbon footprint for all exported goods might become a long-term source of instability for economies relying on fossil fuels.
- Banks and financial institutions are assessing climate risks and becoming more reluctant to provide financing for fossil fuel projects (UNEP 2019). This trend is most visible in the coal industry (BANKTRACK 2019), and it will create more obstacles for the further development of conventional energy in resource-rich countries.

2 Russia's Role in the International Energy and Climate Change Landscape and Energy Geopolitics

Despite the fact that Russia produces only 3% of the world's GDP and accounts for only 2% of the world's population, it is the third largest producer and consumer of energy resources in the world after China and the US, providing 10% of world production and accounting for 5% of world energy consumption. Russia consistently ranks first for global gas exports, second for oil exports and third for coal exports. With energy production of about 1470 mtoe, Russia exports over half of the primary energy it produces, providing 16% of global cross-regional energy trade, which makes it the absolute world leader in energy exports (ERI RAS and SKOLKOVO 2019). Its strategic behaviour regarding energy transition is therefore important not only for the country itself, but also for the rest of the world.

From a climate perspective, the country ranks fourth globally in terms of carbon dioxide emissions. Russia continues to rely on fossil fuels, while its GDP energy intensity remains high amid relatively low energy prices and high capital costs. The share of RES (solar and wind power) in the energy mix is negligible, and officially is not projected to rise above 1% by 2035.

From an energy geopolitics viewpoint, Russia is traditionally regarded as a resource-rich country and is accused of abusing its power as an energy (especially natural gas) exporter. In the Energy Strategy of the Russian Federation up to 2030, it is explicitly stated that, “energy exports should help to promote the country's external policy”. Russia's use of geopolitical power in the field of energy increased during the 2000s, mainly due to Russia's use of its energy exports in its political relationships with post-Soviet states, as well as the strategic and economic effects of new Russian export pipelines to Central and Eastern Europe. It was mainly applied to influence the political behaviour of those countries purchasing Russian energy. However, the metaphor of an “energy weapon” is misleading: Russia has not used tough means of influence—the so-called ‘hard energy weapon’—in the context of Western Europe (Tynkkynen et al. 2017). Nevertheless, the image of a dangerous, unpredictable player in the global energy geopolitics game has defined Russia for the last two decades.

3 The Direct Influence of Energy Transition on Russia

As mentioned above, there are two direct ways in which energy transition can influence different countries: first, through the official targets and NDCs set by international climate change agreements which influence national strategies to reduce carbon, and, secondly, by commercial decisions taken by the main investors and other stakeholders active in the country in order to take advantage of innovations and green technologies.

4 Russian Climate Policy and the Paris Agreement

Decarbonization is the main global driver of energy transition. Individual regions, countries or their associations set goals for reducing the carbon footprint in the energy sector and introduce mechanisms to stimulate this process—carbon taxes, emissions trading systems, etc. According to the World Bank Group (World Bank and Ecofys 2018), fifty-one carbon pricing initiatives have been implemented or are scheduled for implementation in regional, national and subnational jurisdictions. Consequently, during the period 2008–2017, the carbon content of electricity decreased by 50–100 gCO₂/kWh in the European Union, US, Canada, China, Australia, Kazakhstan and many other countries (Staffell et al. 2018).

Despite the global trend, for many years, the climate agenda and drive for decarbonization were not essential factors in the economic and energy strategy of the Russian Federation. Russia signed the Paris Agreement in 2016, with voluntary obligations to limit anthropogenic greenhouse gas emissions to 70–75% of 1990 emissions by 2030, provided that the role of forests was taken into account as much as possible. But even with this very low target (which does not require any significant effort given the country's economic stagnation), Russia has not ratified the Agreement although it did finally join the Agreement in September 2019 (without official ratification, just by the decree of Prime Minister Dmitry Medvedev).

It is still unclear exactly what Russia's climate goals will be under the Paris Agreement. A few important milestones are envisaged in 2020, including the development of a Low-Carbon Strategy for Russia up to 2030 and beyond, and the adoption of a carbon regulation framework. But it is worth noting that there are still many strong opponents to the Paris Agreement and carbon regulation in Russia, including some representatives of the authorities, fossil fuel businesses and the scientific community. Currently, discussion is mainly focused on delivering good reports and 'greenwashing', as opposed to real climate action.

The Paris Agreement is mentioned only once in the draft version of "Russian Energy Strategy Up to 2035", a key document defining the country's strategic priorities in this critically important industry, which was submitted to the government by the Energy Ministry in 2015, but which has still not been officially approved. It states that "in 2016, the Russian Federation signed the Paris Climate Agreement, which included, among other things, the development by 2020 of a strategy of socio-economic development with a low level of greenhouse gas emissions for the period until 2050. In order to minimize possible negative consequences for the Russian fuel and energy complex from the implementation of this agreement, an extremely balanced approach is needed to take into account some additional regulatory measures to counter climate change" (Ministry of Energy of the Russian Federation 2017).

This very cautious approach towards decarbonization is driven by several factors:

- Scepticism concerning the anthropogenic nature of climate change dominates among stakeholders—senior representatives of the Russian Academy of Sciences as well as many state officials publicly express their doubts over the very concept

of anthropogenically created climate change. Many experts, academicians and policymakers see it as a concept manufactured by the West to undermine Russia.

- Secondly, following the economic downturn and restructuring in the 1990s, Russia de facto reduced greenhouse gas emissions sharply (by about 30%). Between 1998 and 2008 emissions increased in line with GDP growth, while in the period 2010–2016 Russia’s GDP has grown by 73%, while the level of emissions has increased by only 12% due to further economic restructuring and faster growth of the financial and other non-energy-intensive sectors (KOMMERSANT 2016). As a result, Russia is currently well within its emission limits due to the high initial starting point in 1990 and economic stagnation since then.
- Lastly, Russia’s energy sector has a lower carbon footprint than many other countries, including Poland, Germany, Australia, China, India, Kazakhstan, the Arab countries of the Persian Gulf, the US, Chile and South Africa. Around 35% of electricity is generated by carbon-free Nuclear Power Plants (NPPs) and large hydropower plants, and 48% comes from gas (IEA 2018), with gas gradually displacing petroleum products and coal from the Thermal Power Plant (TPP) fuel basket (the share of gas in TPP electricity generation has increased from 69 to 74% during 2006–2017).

This background explains why Russia has sidestepped the global decarbonization trend for so long. Its participation in international environmental cooperation has always been determined primarily by its external policy objectives. In Soviet times, participation in global environmental initiatives was a channel of collaboration with the West. In the 1990s, it was a means of integration into the international community and one of the major areas of cooperation with the US. In the 2000s, Russia used the environmental agenda to gain trade-offs from Western partners along with attracting foreign investment (Makarov 2016). At present, an understanding of the possibilities to reap benefits from the country’s natural capital is slowly increasing among Russian political and business elites, so in the longer term Russia’s involvement in international environmental cooperation may be catalysed by an increasing need for international re-integration.

5 Businesses Promoting Green Technologies in Russia

Businesses in Russia currently seem to be more preoccupied by the climate and energy transition agenda than the authorities. Initially, export-oriented companies started to realize the threat of changing perceptions and regulations for their traditional business, in particular, steel and aluminium making companies, as well as paper and chemicals businesses. Producers are now hurrying to implement ESG reporting to please their investors and to develop “green products” (green steel, green aluminium, etc.) using new energy technologies and different offset mechanisms in order to remain competitive in their core export markets. From their perspective, the

decarbonization of the Russian energy sector and the expansion of RES is needed urgently.

There is also a rising cluster of companies interested in RES development as their main market, namely, equipment producers for solar and wind farms. Several oligarchs (such as Anatoly Chubais and Victor Vekselberg) have entered this business and have now become its strongest proponents. Their commercial targets are related to export expansion and so they are extremely interested in cooperation with other countries which could become export markets for their equipment. The primary targets in this respect are the former Soviet republics which prefer not to further increase their dependence on China. Current volumes of trade are negligible, but it is possible that at some point this could create tension between Russia and China.

6 National Technology Policy

While not paying particularly serious attention to climate policy, Russia is on the other hand very sensitive to its rate of technological development. The country's leadership clearly realizes that Russia runs the risk of falling behind in the development of new energy technologies that have become standard in most of the rest of the world. This is the reason behind its strict requirements on equipment localization for renewable energy and smart grids, and numerous import substitution programs. Despite this realization, energy transition technologies are definitely not the main focus of Russia's technology policy. In the key state document which defines priorities in this area, (the State Program for "Energy Development" approved in 2014 and amended in 2019), only the "promotion of innovative and digital development of the fuel and energy complex" is mentioned as a target, together with many new technologies in hydrocarbon production and processing. Nothing at all is mentioned concerning low-carbon technologies (Ministry of Energy of the Russian Federation 2019a).

The desire to overcome the technological gap and to reduce the potential need for imports if energy transition becomes mainstream has created some interest among Russian authorities concerning technologies for energy transition. Several huge grant programs and networks have been created for this purpose (RVK, Energynet, etc.), but surprisingly they are mainly focused on digital technologies, rather than low-carbon ones. Russian authorities regard the digital transformation of the energy sector as a technological challenge (bearing in mind the high level of current import dependence for all high-tech equipment and the potential threat of sanctions, which could create serious problems for national energy security) and this is the reason why digitalization has become the main driver of energy transition in Russia. In 2018, Vladimir Putin signed a decree establishing a special state program for the creation of a "Digital Economy" in which energy infrastructure is mentioned as one of the key components. The Energy Ministry has also developed its special project called "Digital Energy" (Ministry of Energy of the Russian Federation 2019b) which is focused primarily on

the digitalization of regulation and the creation of a whole institutional framework for a wide-scale introduction of digital technologies in the energy sector.

As the main drivers of this movement are the fear of technological lag, import dependence on foreign equipment and, even more importantly, software (especially given the threat of new sanctions in the energy sector), no large-scale international cooperation can be expected in this area. Indeed, protectionism and the creation of various trade and economic barriers is highly likely.

7 Indirect Influence

The indirect consequences of the energy transition are more obvious and sensitive for Russia. Any changes in the demand for fossil fuels result in lower energy exports, while the potential introduction of BCA (Border Carbon Adjustments) might become a threat for all Russian exports, and new rules of behaviour by investors could further constrain the availability of funding for Russian energy projects.

8 Energy Transition Limits Demand for Fossil Fuels and Constrains Russian Energy Exports

Energy transition affects regional energy balances, specifically when RES implementation starts to limit growth or reduce overall demand for fossil fuels. For example, rapid reduction in coal use in the EU energy balance threatens Russian exports to Europe, which have already dropped considerably during the last decade. The share of electric vehicles in key markets (China, the US, EU) is forecast to grow rapidly, which is likely to reduce the demand for petroleum products. In 2018 in India, solar energy (PV) was 14% cheaper than coal generation, while China will achieve network parity in 2020 which will reduce demand for imported pipeline gas and LNG, all of which will impact regional energy balances.

For Russia, as for many other resource-rich and energy-exporting countries, energy transition creates new long-term challenges and calls into question the sustainability of the whole economy, which is highly dependent on hydrocarbon export revenues. In the period from the beginning of the 2000s, Russia managed to increase its energy exports dramatically: from 2000 through 2005, exports grew by an unprecedented 56% (ERI RAS and AC RF 2016), exceeding the total energy exports of the USSR, providing an incredible acceleration of the national economy and underpinning the country's position on the international arena as an "energy superpower". But as the global financial-economic crises came in 2008, the growth in energy exports halted. The post-crisis years of 2011–2014 witnessed very high oil prices but stagnant export volumes, and a lack of petro-dollar revenues resulted in GDP stagnation at an

oil price of 110 \$/bbl, which was a clear evidence of deep structural economic problems. More recently, oil and gas export revenues have declined from the heights of 2008–2012 under the impact of falling prices for hydrocarbons. Nonetheless, even in 2017, hydrocarbons provided 25% of GDP and 39% of the country's federal budget, 65% of foreign earnings from exports, and almost a quarter of overall investment in the national economy (Trading Economics 2018).

Obviously, the energy transition affects the prospects for Russian fossil fuel exports, particularly coal and oil, but natural gas exports might also be significantly affected by a further increase in emission reduction goals. Indeed, economic modelling has shown that climate-related actions outside Russia could lower Russia's GDP growth rate by about a half a percentage point (Makarov et al. 2017). ERI RAS-SKOLKOVO analysis (ERI RAS and SKOLKOVO 2019) has demonstrated that the role of the fuel and energy complex in the Russian economy will continue to decline from its peak in 2012–2013, affected by shifts in world energy markets. The technological transition of the world energy sector from the dominance of fossil fuels to low-carbon energy resources could lead to a 16% reduction in fuel exports and an 8% reduction in primary energy production in Russia over the next two decades. In general, by 2040 this could reduce the value added by the fuel and energy complex by a quarter and value added by supporting enterprises by another 2–3%, due to a decrease in capital investments within the sector. As a result, average GDP growth in the country is forecast to slow down between 2016 and 2040 from 1.7 to 0.6% per annum and the share of the energy sector in Russia's GDP will decline from 25% to just 14%. This signifies the end of the dominance of the fuel and energy complex in the national economy during the Energy Transition.

There is little if any hope within Russia that this downward movement will be mitigated by internal factors. GDP growth projections have been revised downwards to 1–2% per annum due to ongoing systemic economic crisis, international financial and technological sanctions and an unfavourable investment climate. Gone are the years of high GDP growth (7–8% per annum) in the first decade of this century. Russia is feeling the impact of a stagnating economy, flat domestic energy demand, the necessity of keeping domestic regulated prices unchanged and insufficient investment in the deployment of new technologies. This situation, which limits investment capacity, is further compounded by the high cost of capital in the domestic financial market and the negative impact of financial sanctions.

As a result, the global rise in RES targets and the transition towards a decarbonized energy economy are regarded in Russia as a significant threat for export revenues and thus for Russian economic, and therefore political, security (GARANT.ru 2017).

9 Carbon Tracking of Internationally Traded Goods and The Creation of Border Carbon Adjustments (BCA) Challenge Russia's Non-energy Exports

Russia also faces the risk that market barriers for its exports of energy-intensive goods, which constitute currently 30% of exports, could be introduced. These restrictions are currently under discussion in Europe and in other parts of the world and might soon become an important component of international trade. Under these circumstances, Russian energy-intensive, export-oriented industries—initially the metallurgical and chemical sectors—might face significant problems in protecting, never mind expanding, their niche in export markets.

10 Difficulties in Attracting International Financing for Fossil Fuel Projects

Another important implication, which makes Russia's perception of energy transition so negative, is a further increase in the difficulty of attracting international financing for domestic fossil fuel projects. Many global banks and investment funds have already removed coal projects from their portfolios, and some have started to refuse to finance oil projects. Financial sanctions currently in place are already a serious burden for the development of Russian energy projects, and so further restrictions due to climate considerations would make life even more difficult.

11 Russia's Potential for Energy Transition and Its Geopolitical Implications

As shown above, the climate agenda is not a major policy issue in Russia, while the competitiveness of the national economy, as well as its energy security, is already protected by cheap abundant hydrocarbons (primarily natural gas). As a result, for Russia the only important driver for energy transition is technological progress and a desire to prevent the emergence of a strong technological gap between it and other countries. Nevertheless, despite this limited motivation to promote energy transition in Russia, there are some areas where the potential benefits are huge and which could create substantial value for the Russian economy, attracting considerable investment if proper regulation was to be put in place. These key areas for Russia are the following:

- Energy efficiency,
- Renewables,
- Decentralization and distributed energy resources, and
- Hydrogen.

12 Energy Efficiency

Factors relating specifically to Russia—the cold climate, the vast distances, a huge endowment of natural resources, poor economic organization and marked technological backwardness—have resulted in its economy having a high level of energy intensity, 1.5 times higher than the world average and that of the US, and twice that of the leading European countries (ERI RAS and AC RF 2016). Across practically all industrial sectors, there is a substantial energy efficiency gap compared not only with the best available technologies but also with current performance in other countries. Even with comparatively low fuel and energy prices, the share of fuel and energy costs in overall production costs in Russia is higher than in developed and many developing countries (Bashmakov 2013). Before the 2009 economic crisis, Russia was one of the world leaders in terms of GDP energy intensity reduction rates, and the gap between Russia and developed countries was narrowing dramatically. A 40% reduction of GDP energy intensity within ten years was achieved between 1998 and 2008; however, since 2009 this reduction has slowed down and even reversed.

Obviously, for such an energy-intensive economy, issues such as energy efficiency and conservation are key for any Energy Transition plan: according to analysis from the IEA 30% of primary energy consumption and enormous amounts of hydrocarbons (180 bcm of gas, 600 kb/d of oil and oil products and more than 50 Mtce of coal per annum) could be saved in Russia if comparable OECD levels of efficiency were to be achieved (IEA 2011). A significant reduction in the growth of energy consumption could be provided by structural energy conservation (changing the industrial and production structure of the economy), with an increase in the share of non-energy-intensive industries and products. The next most important factor in constraining the growth of energy consumption could be improved technical application of conservation processes which could provide a total energy saving of 25–40%. However, it will be extremely difficult to close the gap with OECD countries—it is actually widening due to a lack of investment in processes which could quickly renew assets or improve energy efficiency. If we also include ongoing administrative barriers and, most importantly, a lack of availability of ‘long money’ and of credits for energy efficiency projects for small market participants, coupled with the persistence of relatively low natural gas prices in the long term, then Russia could well remain stuck in a state of high energy intensity. Strong policies are required to change this pattern, accompanied by a substantial increase in energy prices.

Unfortunately, at present, there appears to be little incentive for anything to change, unless Russia can develop energy efficiency technologies which could then be exported to the rest of the world. Internally, it would seem to be too politically risky either to raise prices or to force spending on energy efficiency at a time of economic stagnation.

13 Renewable Energy Sources

Russia's energy balance is strongly dominated by fossil fuels, with natural gas providing 52% of total primary energy demand, coal providing 18% and oil-based liquid fuels a further 18%. Carbon-free sources of energy in Russia are represented primarily by large-scale hydro and nuclear (which enjoys strong state support). The role of solar, wind, biomass and other sources of renewable energy is negligible—less than 1% of the total supply (ERI RAS & AC RF, 2016). The total share of RES (including hydro, solar, wind, biomass and geothermal) in Russia's total primary energy consumption was just 3.2% in 2015. By the end of 2015, total installed renewable power generation capacity was 53.5 gigawatts (GW), representing about 20% of Russia's total installed power generation capacity (253 GW) with hydropower providing nearly all of this capacity (51.5 GW), followed by bioenergy (1.35 GW). Installed capacity for solar and onshore wind by 2015 amounted to 460 MW and 111 MW, respectively (IRENA 2017).

According to the draft Energy Strategy of Russia for the period up to 2035 (Ministry of Energy of the Russian Federation 2017), the share of renewable energy in Russia's total primary energy consumption should increase from 3.2 to 4.9% by 2035. This includes Russia's approved plans to expand its total solar PV, onshore wind and geothermal capacity to 5.9 GW by the end of 2024. The foundation for the growth of RES deployment in Russia is Decree 449, passed in 2013, which created a legal framework to establish a renewable energy capacity system in the country. The decree is designed to encourage the development of renewable energy in Russia, particularly focusing on wind and solar photovoltaics, and to a lesser extent, small-scale hydropower. Under the new regulatory system, energy developers of projects with an output of at least 5 MW can bid for capacity supply contracts with Russia's Administrator of the Trading System via annual tenders. Winning suppliers are paid both for the capacity they add to the energy system and for the energy they supply, based on long-term, 15-year contracts with fixed tariffs. This regulation sets a predictable legal and regulatory environment that allows developers to commercialize capacity as a separate commodity to the power itself and ensures the economic attractiveness of these projects for investors. In return, RES developers are expected to ensure they can provide the promised capacity, within the right timescale and with sufficient localization of equipment (Power Technology 2018).

Since then annual renewable capacity additions have risen from 57 MW in 2015 to 376 MW in 2018 (320 MW solar, 56 MW wind). What is more significant, however, is the significant decline of capital expenditure in the renewables auctions which have taken place during the last two years: by 35% for wind and by 31% for solar, according to the Energy Ministry (Ministry of Energy of the Russian Federation 2019b). This process was not smooth, as some capacity auction rounds have struggled to attract bids. Just over 2GW of renewable capacity was awarded in tenders between 2013 and 2016, while the 2017 auction resulted in a total of 2.2GW of wind, solar and small hydro awarded in a single round. In 2018, 1.08GW of capacity was allocated between thirty-nine projects. Additionally, in 2017 five waste-to-energy projects were

introduced to the capacity market scheme, with a total capacity of 335 MW. But in 2018, the tender for waste energy capacity failed, due to strict new requirements for bidders to provide performance guarantees.

As technological policy is the main driver of Russia's interest in renewables, the country is focused on building its own RES manufacturing capacity. Russia has set a relatively high level of local content which is required to qualify for the highest tariff rates, an essential component of many Russian RES projects' long-term feasibility. The percentage of Russian-made equipment required to avoid tariff penalties was relatively modest in the early days of the auction system but has now risen to 65% for wind farms and small hydro, and 70% for solar until 2020, with the long-term target level of localization set by the government at 80%. These high levels have been behind the failure of several tenders, especially in wind farm development, for which there has been little to no Russian-made equipment proposed. The requirements have encouraged foreign firms to partner with Russian power companies and manufacturers. Several international joint ventures have been established including Fortum and state-owned technology investor Rusnano's wind investment fund, and WRS Bashni, a partnership between Spanish developer Windar Renovables, Rusnano and Russian steel firm Severstal. Wind equipment was localized by Vestas Manufacturing Rus in the Nizhny Novgorod region, while SGRE (Siemens-Gamesa Renewables) and Lagerwey are also entering the Russian market (Power Technology 2018).

The problem is that the current support mechanism will expire in 2024. Russia's unambitious RES targets and ambitious localization targets will be nearly fulfilled by this time, and the influx of foreign renewables developers might stop if no new incentives for the RES market are created. But in order to create these incentives, the Russian government needs to first confirm the long-term role of renewables in its energy balance, which is rather difficult to do without a decarbonization agenda.

However, it seems that as a country with the world's largest natural gas reserves and the second-largest reserves of thermal coal, Russia does not see any real value in transitioning from fossil fuels to zero-carbon energy sources. Despite the country's massive potential in wind and solar resources and the virtually limitless land available for development, the availability of oil, gas and coal is suppressing clean energy development. Diversifying this energy mix towards carbon-free energy sources is a challenging task: low prices for hydrocarbons, the unfavourable geographical dispersal of potential renewable resources from the point of their utilization (they are mainly concentrated in non-populated areas with a long distance to the centres of consumption) and their comparatively high costs (caused mainly by the mandated requirements on localization, which often results in uncompetitive per-unit costs), are hindering the development of these energy sources in Russia.

According to IRENA (2017), Russia theoretically has the potential to increase its share of renewables from 4.9 to 11.3% of total primary energy consumption by 2030. However, without a reassessment of its energy strategy priorities and a wider transformation of its energy system, this will not be achieved. As a result, it seems that the only real incentive to develop any form of new technology will be the export market. If Russia could export renewable electricity or technology it might be worth pursuing, but for domestic use it is a real challenge, unless it becomes significantly

cheaper. In addition, for the country as a whole, the real economic necessity is to maintain export revenues, which has resulted in enthusiasm for potential hydrogen export to Europe, as this is where the real incentive seems to lie.

14 Russia's Decentralization and Distributed Energy Resources Potential

Historically, the Russian energy system has always developed in an extremely centralized way. The Russian electricity sector, for example, relies on a huge centralized power system, while distributed energy resources, including microgrids based on renewables, are developing slowly and only in remote and isolated areas. Russia has one of the world's largest national centralized power systems with single dispatch control; as of 2017, the total length of its trunk networks was over 140 thousand km, its distribution networks were over 2 million km and the installed capacity of power plants was 246.9 GW. This energy system was created and historically developed on a hierarchical basis with centralized long-term planning bodies. For decades, the centralized model has been, and remains, the basis of its energy strategy. The role of distributed generation has historically been significant only in remote areas of the Far East, Siberia and the Arctic, which are too expensive to connect to a single network. However, the penetration of distributed energy resources (DER) into the centralized system has now begun, with potentially significant consequences for the incumbent actors.

Decentralization in the power sector began when the role of economies of scale in power generation globally ceased to be significant due to technological improvements. The catalyst for this change was the emergence in the 1980s of gas turbines and reciprocated gas engine technologies. It was the reciprocated gas engine global market that showed steady growth rate (CAGR 17%) until the late 2000s (Diesel and Gas Turbine Worldwide 2006). In the US, distributed generation has played a role in the electric power sector for several decades (Rhodium Group 2017). Historically, these DERs have consisted of dispatchable resources; however, the recent increase of non-dispatchable PV capacity marks a change in this trend. BNEF's forecast shows that the decentralization ratio will exceed 15% (as it did in Germany in 2017) in eight countries by 2040 (BloombergNEF 2017). Globally, annual distributed generation capacity additions have already exceeded centralized ones, and non-generation types of DER have even more potential than distributed generation. The estimated potential for Demand Response and Energy Efficiency in the US in 2014 (37 GW) was higher than for CHP (18 GW) or Solar (8 GW) (Rhodium Group 2017). In line with other countries, the integration of DER into the Russian electricity sector became noticeable in the 2000s, but in the past seventeen years it was limited to distributed generation only. The development of this process in Russia is driven not by global climate change or energy independence concerns, but by the economic considerations of the largest electricity consumers. Almost all the big Russian industrial companies

(including oil and gas industry leaders like Gazprom, Rosneft, Lukoil, Novatek and Sakhalin Energy) are involved in distributed generation projects in order to get a more affordable power supply. Meanwhile, micro-generation using renewables for households in Russia is still largely confined to enthusiasts. There are just a few cases evident in the regions, all of them stimulated almost only by economic expediency reasons.

However, non-generation types of DER in Russia are only in the very early stage of development. Demand response technologies began to develop in the country in 2016–2017, but only a small proportion of power consumption is affected (for example, 54 MW in the second price zone of the wholesale power market, or 0.1% of total capacity in this zone). Demand response in retail electricity market is in its experimental stage, and energy efficiency policies have not yet achieved significant results. According to I. Bashmakov (Bashmakov 2018), GDP energy intensity in Russia in 2017 is just 10% lower than in 2007, a disappointing outcome given that the initial energy efficiency target set in 2008 was to reach a 40% decline in GDP energy intensity by 2020. Substantial federal budget subsidies were allocated but very limited change has occurred, and as a result the initial target has been significantly scaled down to 9.41% and federal funding has been discontinued (Ministry of Economic Development of the Russian Federation 2018).

Nevertheless, DER has significant potential in Russia. According to a study by SKOLKOVO Energy Centre (Khokhlov et al. 2018), it has the potential to cover over half of the needs for generating capacity (about 36 GW by 2035) if even a small part is actually utilized. The most promising type of DER in Russia is distributed co-generation (~17 GW). On-site self-generation units owned by electricity consumers can provide an additional 13 GW, demand response another 4 GW, energy efficiency technologies a further 1.5 GW and rooftop PV systems up to 0.6 GW. Indeed, if DER is fully utilized, the Skolkovo analysis shows that the entire generation gap in 2035 could be covered, although this would require significant acceleration from today's levels and a major push by the Russian government to introduce a favourable policy framework. However, although DER has been widely analysed in international literature, in Russia there has been no integrated assessment of its potential in response to future development needs of the national power system and as a result progress is likely to be slower than might be hoped.

In order to stimulate the maximum utilization of DER technologies, systemic changes are necessary in the architecture and policy of the Russian power sector, balancing the interests of new players with the existing model. An optimal combination of centralized generation and DER will need to be found, but in order to find such an outcome it will be necessary to develop principles and market mechanisms for the integration of centralized and decentralized parts and to ensure their reliable joint operation. The Russian authorities are some way from achieving this at present.

15 Nuclear

Russia is one of the world's largest producers of nuclear energy. Its nuclear industry has a role to play as an existing giant with decarbonization credentials. Russia is recognized for its nuclear expertise, and it is pursuing an ambitious plan to increase sales of Russian-built reactors overseas. Currently, it has thirty-nine reactors either under construction or planned overseas.

Moreover, Russia is attempting to create a new breakthrough in nuclear technology: nearly, all of the world's *reactors* operate with thermal (slow) *neutrons*, while *Russia* has developed *fast neutron reactors*, through which it hopes to take the significant step of closing the fuel cycle. Currently, Russia is a world leader in fast neutron reactor technology and is consolidating this through its *Proryv* ('Breakthrough') project. Starting in 2020–2025 it is envisaged that fast neutron power reactors will play an increasing role in Russia, with substantial recycling of fuel. Indeed, fast reactors are projected to account for some 14 GWe of capacity by 2030 and 34 GWe by 2050. If successful this new technology platform envisages a full recycling of fuel, balancing thermal and fast reactors, so that 100 GWe of total capacity requires only about 100 tonnes of input per year, from enrichment tails, natural uranium and thorium, with minor actinides being burned. About 100 t/yr of fission product waste would go to a geological repository (World Nuclear Association 2019).

16 Hydrogen

Russia remains isolated from international communities and partnerships which are developing hydrogen technologies and there is no national hydrogen program, and only in the very end of 2019 the first attempts to coordinate various research groups and interested parties appeared. At the same time, there are many resources in Russia capable of producing hydrogen, and there are a number of R&D activities in this area (most, however, far from commercialization) and also some prospective domestic demand niches for hydrogen. There is also design work and scientific development in the areas of production, storage and transportation of hydrogen, as well as its use in mobile transport. In addition, Russia has enormous potential to produce hydrogen and export it on a global scale. Therefore, hydrogen technologies are being spoken about in a positive way both at the largest Russian forums and within the largest Russian companies (Melnikov et al. 2019).

On the production side, there are proven technologies for producing "grey" hydrogen in Russia, similar to those used elsewhere in the world. They are deployed at oil and gas processing plants, metallurgical plants, etc. (methane conversion). All hydrogen produced is used on-site—for example, to improve the quality of hydrocarbon processing. Furthermore, Gazprom and Rosatom are working on technologies for producing hydrogen with a minimum carbon footprint by using adiabatic conversion of methane (Aksyutin et al. 2017) and high-temperature nuclear reactors

(Ponomarev–Stepnoi et al. 2018). These technologies are at a preliminary scientific research stage or (in the case of adiabatic methane conversion) being tested at an experimental laboratory unit. In addition, Russian developers are also conducting laboratory tests on hydrogen generation by aluminium–water reaction¹ and fuel processors for the conversion of natural gas and diesel into a hydrogen-rich fuel mixture² and the release of pure hydrogen from it.³ The Kurchatov Institute and various research centres at the Russian Academy of Sciences are also engaged in scientific research in the field of electrolysis.

However, the present work on the transportation and storage of hydrogen is less developed because it currently tends to be consumed at the place of production. Gazprom, the owner and operator of Russia's gas transmission system, has conducted studies showing the possibility of adding up to 20% hydrogen to transported natural gas, but real experiments have yet to be conducted.

Nevertheless, the resources for hydrogen production in Russia are huge, mainly because the country has such vast hydrocarbon reserves and wind potential. In addition, existing gas transportation infrastructure (including new gas pipeline projects) and a growing natural gas (LNG) industry could provide a foundation in the long term for the development of “blue” hydrogen production and export given the low cost of raw materials and the possibility of hydrogen transportation both via pipelines and in a liquefied form.

According to Gazprom estimates, transporting hydrogen via export gas pipelines could entail a risk of violating long-term contractual obligations related to gas quality and would necessitate additional investments in the gas transmission system. Therefore, the company is considering an alternative, namely, the production of hydrogen from natural gas at the consumer site after methane has been transported through the trunk pipelines. Gazprom has valued the European market for hydrogen produced in this way at 153 billion euros by 2050, according to Bloomberg.

From a Russian perspective, it is also important to note that production of “blue” hydrogen from steam methane reforming can actually be a relatively green option because its generation industry has one of the lowest carbon footprints in the world. Gas-fired thermal power plants dominate in the generation structure (around 48%), while nuclear power plants (18%) and hydroelectric power plants (17%) exceed the share of coal-fired power plants (16%). As a result, the carbon content of electricity produced in Russia is less than in the US, China, Australia, India, Japan, Germany and other countries. In certain regions, particularly where hydro and nuclear dominate, this creates opportunities for the production of what is effectively “green” hydrogen via electrolysis with electricity supplied from the regional electricity grid, without the development of solar and wind power. This can give Russia a significant potential cost advantage. This has prompted interest from international players. For example, Kawasaki Heavy Industries plans to revisit a feasibility study on the export

¹Joint Institute for High Temperatures of the Russian Academy of Sciences, JIHT RAS.

²“Central Research Institute of Ship Electrical Engineering and Technology” (“Central Research Institute SET”), Krylov State Research Centre.

³<http://www.niiset.ru/index.php/vodedprod>.

of hydrogen produced in the Magadan region to Japan. Although this project has not yet received a development go-ahead, interest in such initiatives is likely to increase as the infrastructure develops in the Far East and the cost of hydrogen electrolysis and logistics technologies goes down.

Even greater opportunities could open up for Russia if its renewable energy potential is ultimately realized. Currently, the share of green hydrogen produced at RES plants (electrolysis) is nearly zero. But although the share of wind power in Russia's energy balance is currently insignificant (less than 1%), the total potential from this sector is estimated at 17.1 thousand TWh, which is sixteen times higher than total generation in Russia in 2018. As a result, many studies of the global potential of "power-to-x" technology refer to Russia as one of the "hidden champions" as its huge potential is currently offset by a lack of interest from the state and the stakeholders.

17 Conclusions on Geopolitical Implications for Russia

It is clear from the analysis above that the global energy transition towards a lower carbon system presents some real threats for Russia. Perhaps the most obvious is financial, with lower hydrocarbon rents meaning lower budget revenues and slower economic growth, with implications for government spending and the wealth of the Russian population at large. This could have implications abroad, if reduced military spending limits Russia's hard power, and at home, if the political regime is undermined by its ability to satisfy the welfare demands of its population. Furthermore, these problems could be exacerbated by the fact that Russia may have a weaker position in international financial markets as restrictions on the availability of capital for carbon-intensive industries may well be increased. In addition, even Russia's non-energy exports may be impacted if carbon tax adjustments are made for imported goods in key markets. The combination of all these factors could weaken Russia's global negotiating position, which could be further undermined by the increased use of renewables in countries where Russia has previously exercised leverage through energy exports. For example, Russia's position in Southern and Eastern Europe is likely to be weakened as those countries become less reliant on imported energy and are able to diversify away from Russian oil, gas and coal. Equally, countries in NE Asia, where Russia is hoping to gain an increasing foothold, thanks to oil and gas exports, could also become less engaged with the Kremlin as their energy needs increasingly focus on alternative sources with lower carbon intensity.

However, despite the presence of these clear threats to Russia's geopolitical status, there are also reasons for optimism, thanks to the country's huge potential as a carbon sink and as a potential developer of new technology. Firstly, it is possible to envisage that Russia could become a leader in the sale of decarbonized oil and gas, in particular, because it has huge potential in forestry. If managed properly, then reforestation could be used by oil and gas producers as a means to offset the GHG emissions in the supply chain and also possibly the CO₂ emissions at the burner tip. Indeed, some oil and gas

companies (Lukoil for example)⁴ are already considering how this strategy might be used to offset their carbon impact in order to improve their global bargaining position. Secondly, Russia has huge wind power potential, especially in the Arctic, and if improvements in technology could allow DC lines to be connected to major consumers in Europe and China, then Russia could become a major exporter of green electricity (The Moscow Times 2019).

Thirdly, Russia is also attempting to develop a unique competence in a new generation of nuclear technology based on a closed nuclear fuel cycle. If it can become a world leader in this field, which could transform the outlook for nuclear energy, it could provide a massive carbon-free energy source for non-OECD countries where energy demand continues to grow rapidly. It would therefore allow Russia to build deep relationships with economies in Africa, the Middle East and South-East Asia, expanding its geopolitical influence significantly. Finally, and more traditionally, Russia could also exploit its gas resources to increase its presence in new market niches, such as the bunker market where LNG could become a much more desirable fuel following the introduction of stricter emissions rules by the International Maritime Organisation (IMO) in 2020.

In addition to these energy-related issues, Russia could also benefit from the opening of the Northern Sea Route as the Arctic ice continues to melt. Although the opening itself would actually be caused by global warming, one key benefit from increased utilization of a shorter route between Europe and Asia could be to reduce the carbon footprint of transport between the two regions, thus limiting further emissions impacts and potentially providing Russia with another source of geopolitical influence, given the importance of this emerging transport route. The implementation of appropriate national decisions on fuel regulation and environmental requirements would be required to maximize this potential as a “green” transport option, but it is certainly possible to see this new source of bargaining power for Russia emerging over the next decade.

18 Overall Conclusion

In the light of Russia’s current position as a major hydrocarbon exporter and consumer, any notion of a rapid energy transformation is problematic. A large-scale shift from hydrocarbons to renewable energy sources provides energy consumers with more choices, meaning that Russia’s control of energy flows becomes a less effective instrument of (geopolitical) power. Furthermore, since the Russian state budget is highly dependent on energy export revenues, a major change in this sector will have a negative impact in many other parts of the economy, including military funding. Lastly, although Russia has plenty of potential for renewable energy, the country does not have a heavy focus on the sector at present and is therefore unlikely to pioneer technological development in the wind and solar industries. Perhaps not

⁴See LUKOIL CSR policy at <https://csr2017.lukoil.com/pdf/csr/en/hse.pdf>.

surprisingly then, although Russia is involved in international climate policy, it does not work to promote it and instead has to date used diplomacy to influence international energy and climate policy in a way that rather discourages change. One key reason for this inactivity is the fact that political power in Russia is ultimately linked with the control of strategic resources (most importantly, hydrocarbons) and the export revenues derived from these resources (Tynkkynen et al. 2017).

Russia's attitude towards Energy Transition is therefore quite controversial: while acknowledging some of the key trends, the country is basically refusing to accept the consequences of its main driver—decarbonization—and is focusing only on attempts to develop technological expertise in its usual centralized manner. Nevertheless, at a certain point the country will have to develop a long-term vision for both domestic energy market development and export strategy in order to adapt to the profound transformation of the global energy system.

However, the domestic market environment is not conducive to the development of transition-friendly energy sources. The institutional environment is too rigid, there is not enough capital available and there is a level of cynicism as to whether it is really needed. The key question is whether the issue of export revenues can be a catalyst, although there are a number of issues in this regard.

Firstly, the real threat from decarbonization concerns exports to Europe, where gas demand in particular could suffer with potentially significant consequences for Gazprom. This has resulted in an initial interest in hydrogen technology, specifically methane pyrolysis, which allows the production of hydrogen and black carbon and where Gazprom claims to have a competitive advantage. However, it remains to be seen whether and how quickly this technology moves beyond the laboratory stage.

In contrast, other markets are less at risk, and as a result it would be a perfectly justifiable strategy to try and re-focus hydrocarbon exports towards Asia, Africa, Latin America, and this has indeed become a long-term goal. However, Europe cannot be ignored because it is too important for short-term revenues, but Russia's real energy transition strategy for the next 20–30 years may just be to become the lowest cost hydrocarbon supplier to emerging economies.

It would also seem that nuclear development could be a part of a transition strategy. It is of course controversial, but arguably Rosatom could become a key export company, not only providing Russia with additional revenues but also strengthening its geopolitical influence, especially in non-OECD countries which still have fast growing energy demand.

Russia may also attempt to establish itself as an equipment and software producer for green energy, but it remains an open question as to whether it can realistically hope to compete with China and the US on a technology front. As a result, its best option may be to make incremental improvements at home while encouraging the coal-to-gas switching model in emerging economies by continuing to offer low-cost gas (and to an extent oil) to markets where the cost of energy supply and improving air quality is more important than any CO₂ emission targets.

Finally, one area of competitive advantage in a decarbonizing energy world may be the potential for reforestation across Russia's huge geography. Companies are gradually waking up to this potential, as even if they do not believe in anthropogenic

emissions as an issue themselves, they can see that a business advantage could be gained from addressing the problem as perceived by other countries. As a result, use of reforestation as a carbon offset mechanism, either for direct gain or to add “green value” to Russia’s hydrocarbon exports, may become a growing theme over the next decade.

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